

The impact of using different parameterizations of unresolved horizontal variability of cloud water in the CCCma GCM

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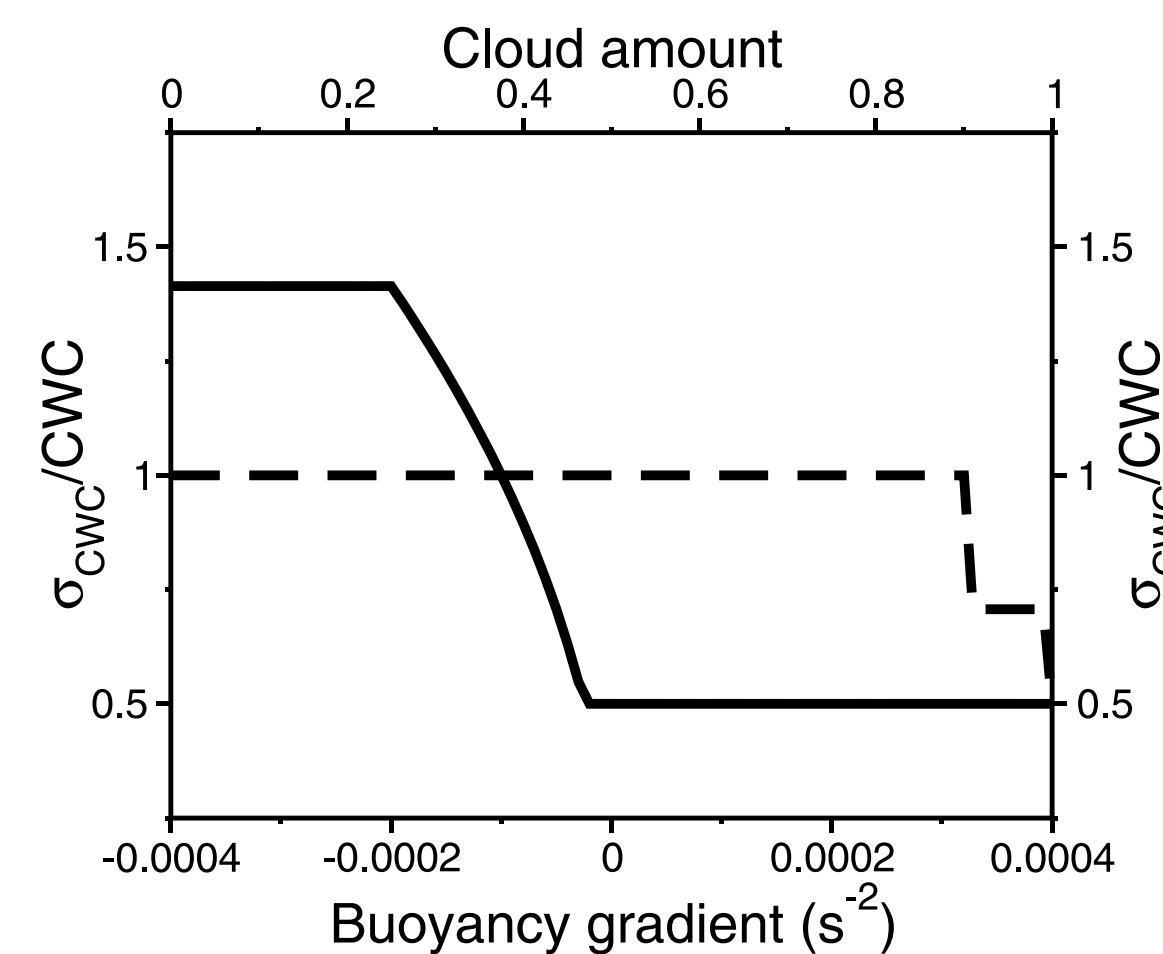
1. Experiments

Exp. 1

If $IWC > 0$ then variability is dashed line
 $\sigma_{CWC}/CWC = f(\text{cloud amount})$

if $IWC = 0$ then variability is solid line
 $\sigma_{CWC}/CWC = f(\text{buoyancy gradient})$

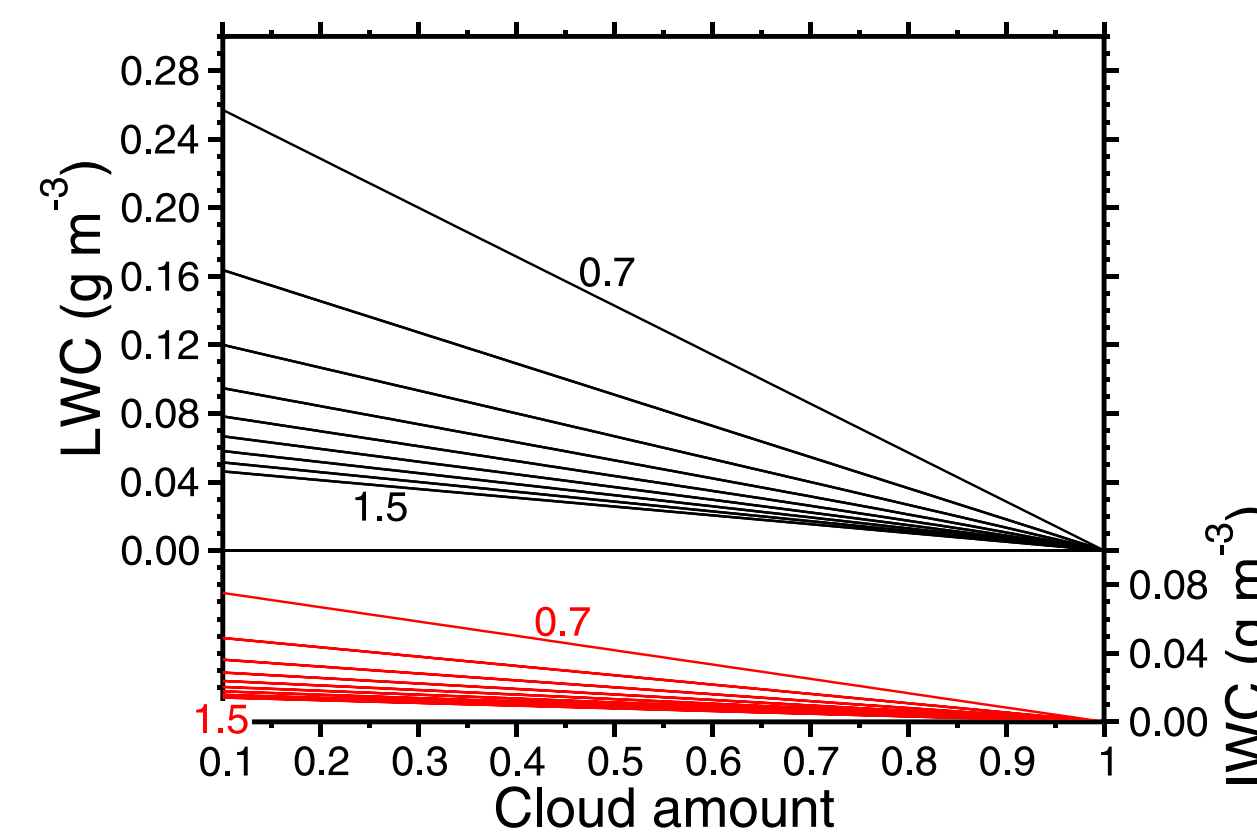
This is the current approach in the CCCma GCM



Exp. 2

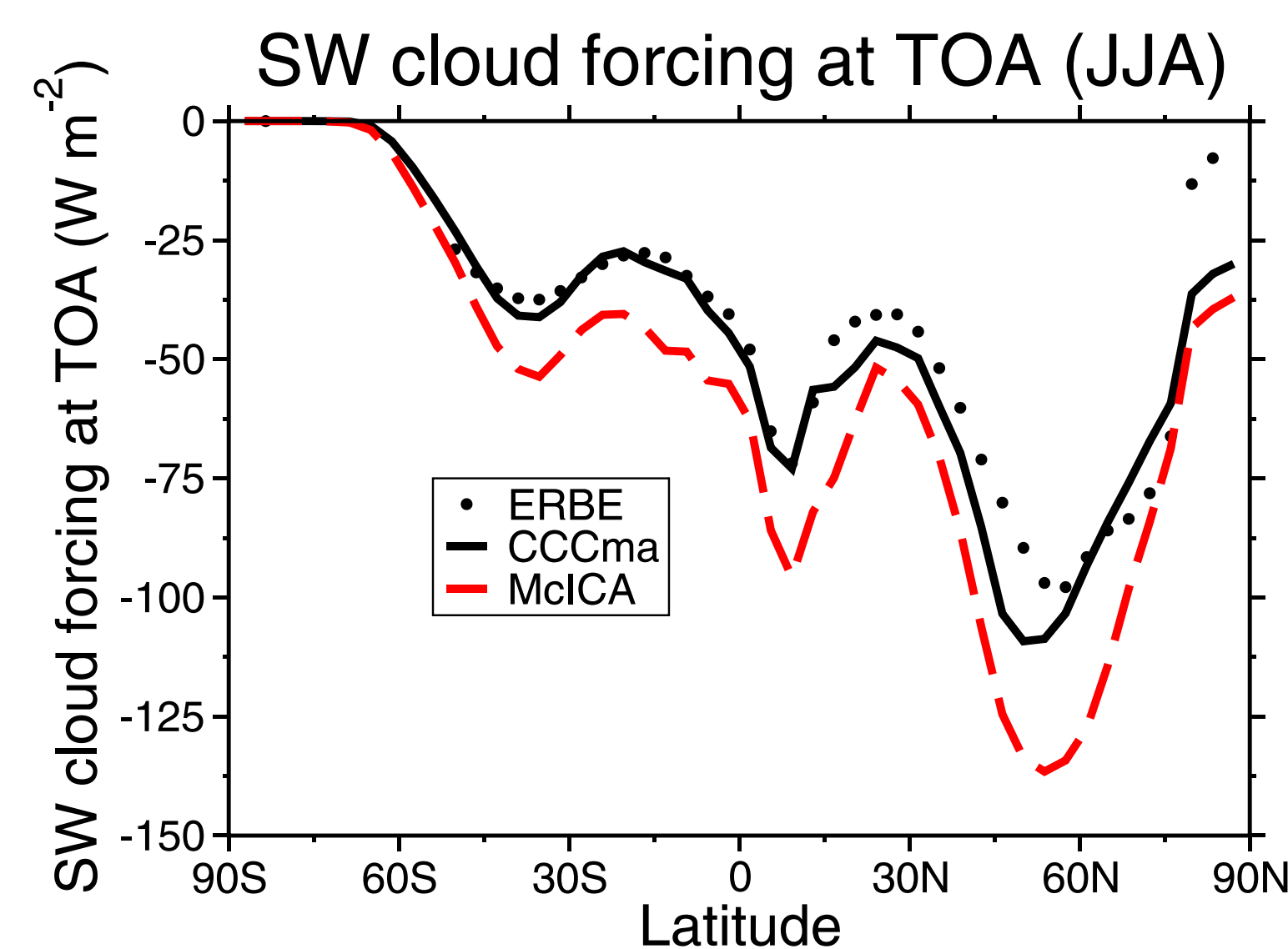
Variability for liquid and ice cloud are functions of cloud amount and cloud water content.

Fits to output from MMF.



Both expts: McICA radiative transfer; variable unresolved effective radii, $r_{\text{eff}} = f(CWC, CDD)$; decorrelation lengths for cloud fraction (x km) and cloud water (y km); 5 year integrations

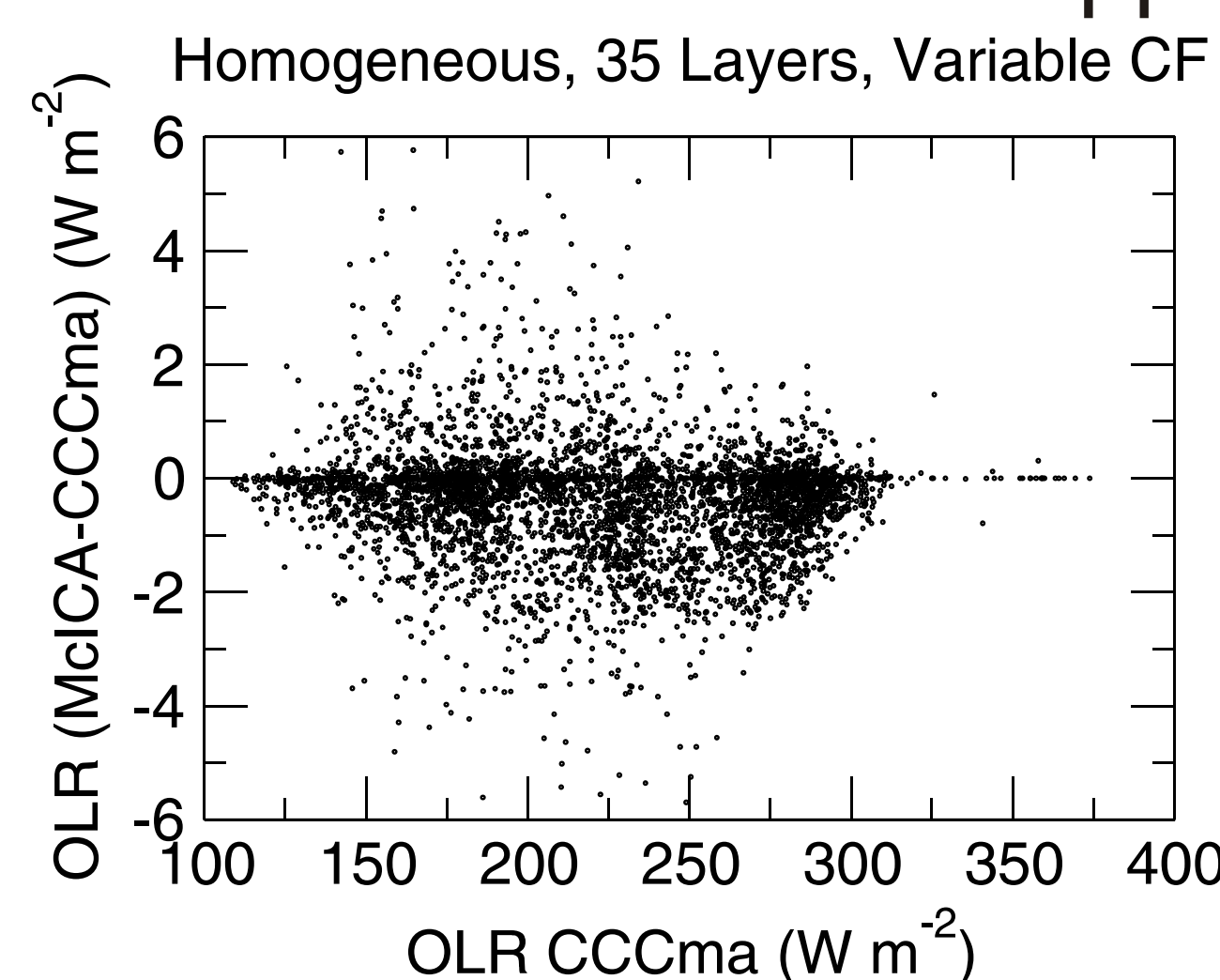
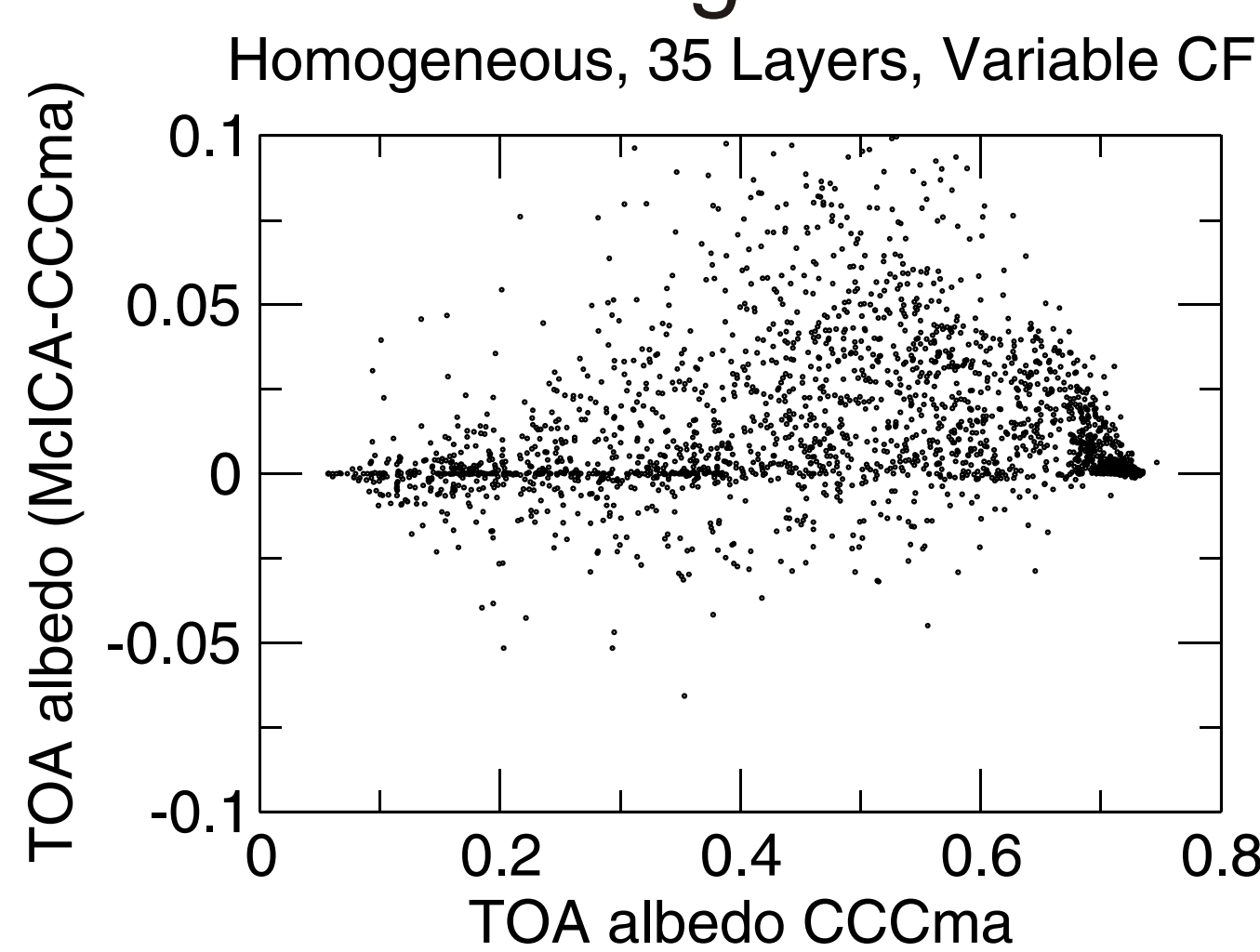
2. Caveat



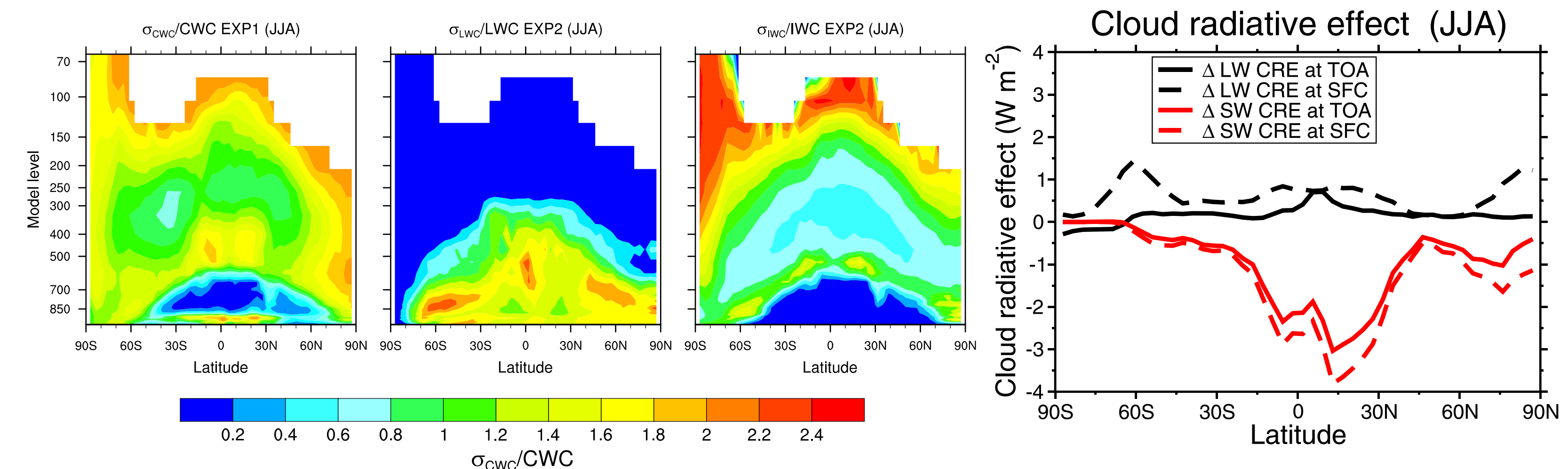
GCM tuned to ERBE using current CCCma radiation code.

McICA generates different fluxes even when using same assumptions about cloud structure

Instantaneous differences for a single GCM timestep
Clouds are homogeneous and maximum-random overlapped



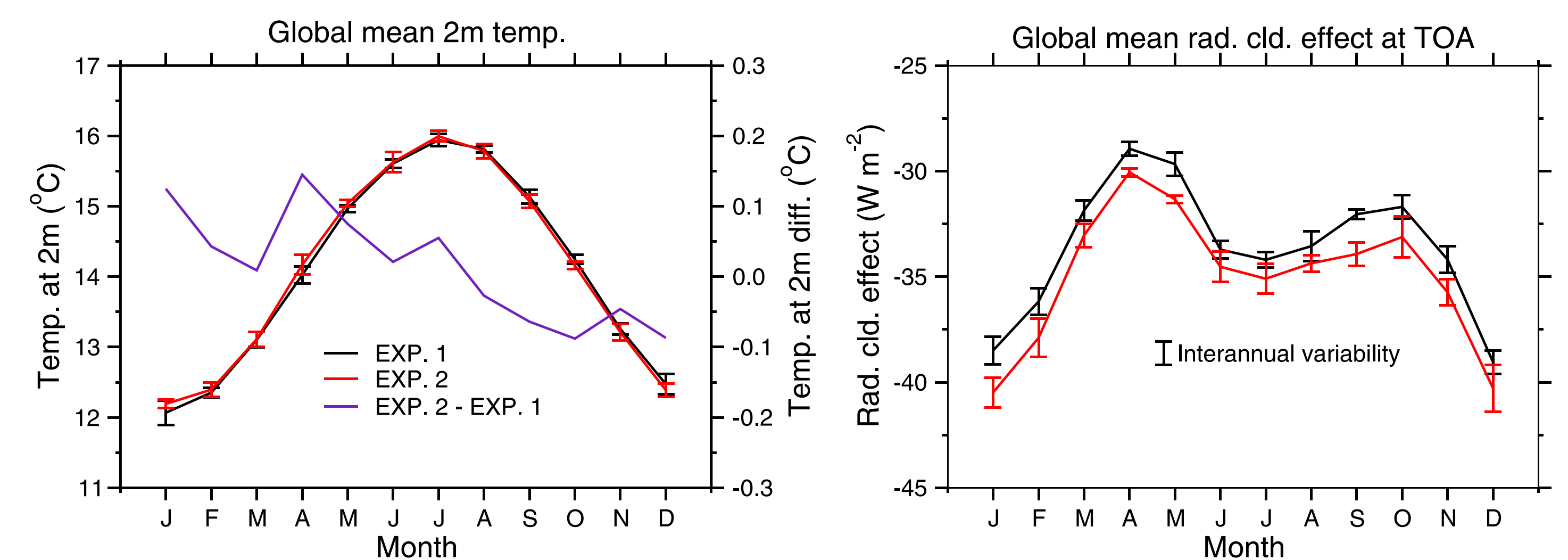
3. Diagnostics



Mid-level ice clouds in Exp. 2 are more homogeneous, liquid clouds more inhomogeneous

Gives rise to larger cloud radiative effects in Exp. 2

4. Results

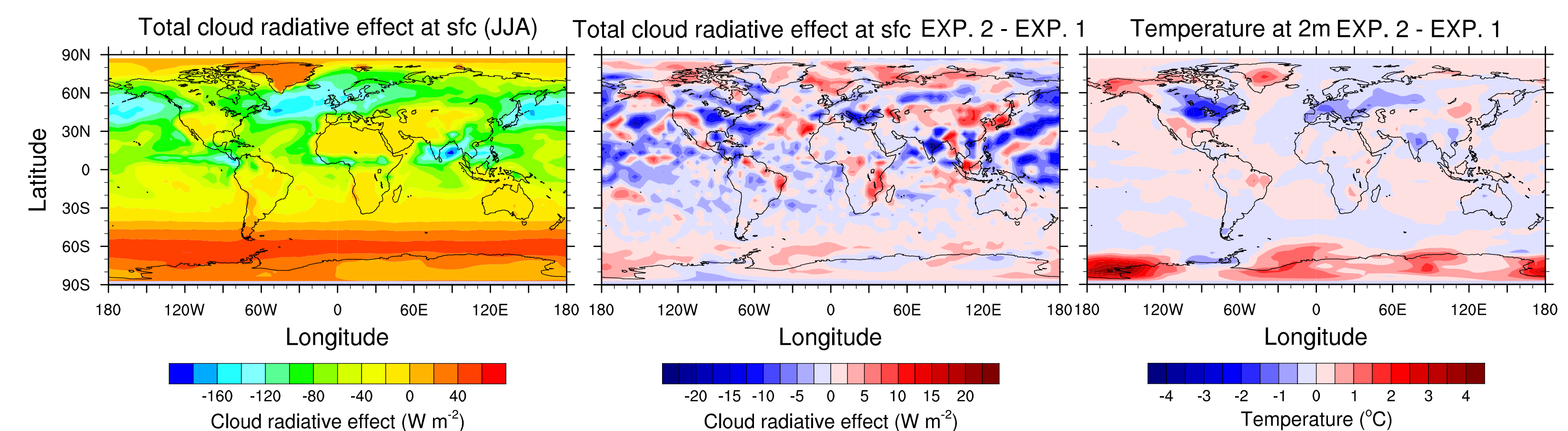


Global mean surface temperature response is small

Expected given that atmospheric model is decoupled from ocean

Notable differences in surface temperature over land

Changes in total cloud fraction and cloud water paths



5. Future work

Tune CCCma GCM with McICA radiation

Examine impact of description of unresolved cloud vertical overlap and horizontal variability (as part of tuning process)?